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A PARTIAL POST-JUVENILE MOLT AND TRANSITIONAL PLUMAGE IN THE SHIKRA (*ACCIPITER BADIUS*) AND GREY FROG HAWK (*ACCIPITER SOLOENSIS*)

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ABSTRACT.—Molt has been poorly studied in the Accipitridae. Examination of museum specimens showed that there are three age-related plumages in the Shikra (*Accipiter badius*) and Grey Frog Hawk (*A. soloensis*) similar to the pattern known in the Levant Sparrowhawk (*A. brevipes*). The juvenile plumage with its distinctively-spotted underside is replaced by a transitional post-juvenile plumage during a partial contour molt between 4–10 mo of age. More feathers on the ventral side than on the dorsal side are replaced during this first contour molt, which is arrested at various stages of incomplete feather replacement. Usually, a significant part of the ventral pattern changes from spotted to barred, whereby the barring is on average more prominent than in adults. The early development of a transitional post-juvenile plumage might be related to early sex signaling. The adult plumage replaces the transitional post-juvenile plumage during a complete molt at about one year of age. In the subspecies *A. b. poliopsis* of the Shikra, which has almost no sexual dimorphism in the adult plumage, the transitional plumage is uncommon and very poorly developed.

KEY WORDS: *Shikra;* Accipiter badius; *Grey Frog Hawk;* Accipiter soloensis; *Levant Sparrowhawk;* Accipiter brevipes; *contour molt; transitional post-juvenile plumage.*

Muda parcial post juvenil y de transicion de plumaje en *Accipiter badius* y *Accipiter soloensis*

RESÚMEN.—La muda ha sido poco estudiada en las Accipitridae. El examen de especímenes de museo demostró que hay tres plumajes relacionadas con la edad en *Accipiter badius* y en *A. soloensis* similar al patrón conocido en *A. brevipes.* El plumaje juvenil con su distintivo salpicado por debajo es remplazado por un plumaje de transición post juvenil durante una muda parcial entre los 4–10 meses de edad. Mas plumas del costado ventral que en el dorsal son remplazadas durante esta muda, la cual se detiene en varias etapas del reemplazo incompleto de plumas. Usualmente una parte insignificante del patrón ventral cambia de salpicado a barrado, en donde el barrado es en promedio mas prominente que en los adultos. El desarrollo temprano de un plumaje post juvenil de transición puede estar relacionado con señales sexuales tempranas. El plumaje adulto reemplaza al plumaje post-juvenil de transición durante una muda completa al año de edad. En la subespecie *A. b. poliopsis* la cual tiene un dimorfismo sexual en el plumaje adulto, el plumaje transicional es poco común y pobremente desarrollado.

[Traducción de César Márquez]

The molt of flight feathers has been studied in some species of *Accipiter* (e.g., *A. gentilis, A. nisus, A. cooperii, A. striatus, A. melanoleucus, A. badius*; Stresemann and Stresemann 1966, Hartley 1976, Fischer 1980, Newton and Marquiss 1982, Schmitt et al. 1982, Henny et al. 1985), but body molt is less well-documented. The larger goshawks generally undergo a complete molt taking several months during the second year of life (Hartley 1976, Fischer 1980). In the Eurasian Sparrowhawk (*A. nisus*), the best-studied species, adults molt during the breeding season in summer. Juveniles also undergo a complete molt that lasts several months during late summer and can continue into the sec-

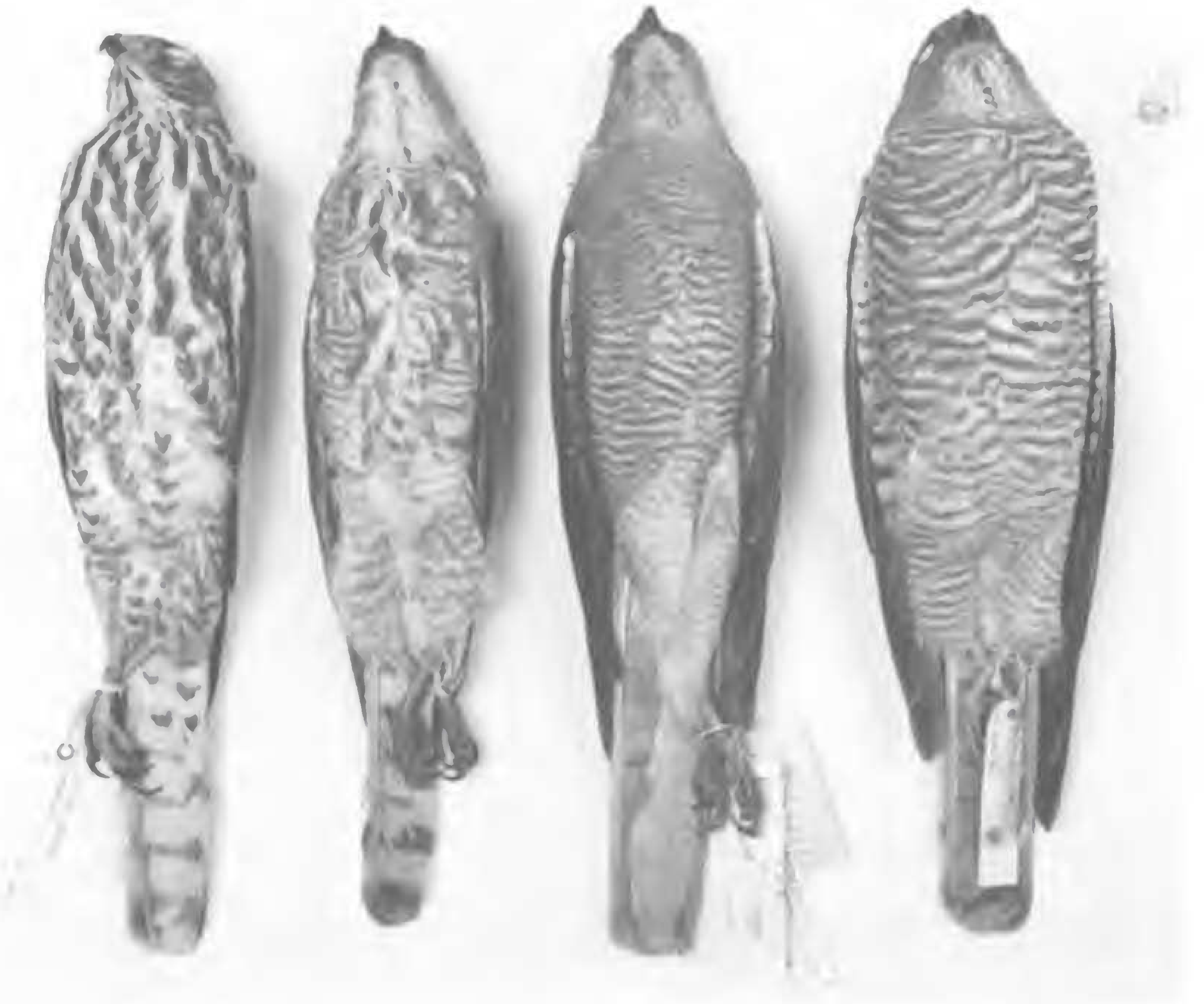

Figure 1. Ventral aspect of the plumages of the Levant Sparrowhawk (*Accipiter brevipes*). From left to right, juvenile (BMNH 1965.M.1087), October, Israel; transitional male (BMNH 1934.1.1.1221), June, Iran (note bold stripes remain from the juvenile plumage and tail feathers juvenile); adult male (BMNH 1956.57.13), May, Caucasus; adult female (BMNH 1934.1.1.1220), May, Iran. Photograph courtesy of the BMNH.

ond year of life (Stresemann and Stresemann 1960, 1966, Newton and Marquiss 1982). During this first molt, all the juvenile plumage is replaced by the adult plumage, except for the odd feather which allows one to identify second-year birds during the next year (Newton and Marquiss 1982). The migratory Sharp-shinned (*A. striatus*) and Cooper's (*A. cooperii*) Hawks similarly molt directly from the juvenile plumage to the adult plumage with a complete molt during the first summer after hatching (Mueller et al. 1979, 1981).

Like the European Sparrowhawk, adult Levant Sparrowhawks (*A. brevipes*) start a complete molt during the breeding season in summer and complete it in autumn, generally before migration (Cramp and Simmons 1980, Forsman 1999). Juveniles, however, undergo a partial contour molt on the wintering grounds in Africa when only about six months old, and return to the breeding grounds in a transitional post-juvenile plumage. Adult plumage is acquired during a complete molt in summer at about one year of age; some birds carry over some juvenile feathers for the next molt (Cramp and Simmons 1980, Clark and Yosef 1998, Forsman 1999). The transitional plumage, which on the underside has a striking mixture of boldly streaked juvenile feathers and barred adult type feathers (Fig. 1; Clark and Yosef 1998, Forsman 1999) is kept only for about half a year, from winter until summer.

Molt information for the Shikra (*A. badius*) is scanty and contradictory. The Asian race *A. b. cenchroides* is said to follow the general pattern of the Eurasian Sparrowhawk (Cramp and Simmons 1980). Thiollay (1975) mentioned that *A. b. sphenurus* in the Ivory Coast only adopts adult plumage in the course of the second year. According to Friedmann (1930), there is an immature plumage with variable underside pattern, and Zimmerman et al. (1996) described an immature plumage resulting from a first molt. Verheyen (1953) rejected the existence of an immature plumage between juvenile and adult in *A. b. polyzonoides* in the Congo. Similarly, Schmitt et al. (1982) did not find any indication of an intermediate plumage in this race in South Africa, where the name Little Banded Goshawk is commonly used, despite the fact that they documented a partial post-juvenile contour molt.

The Shikra and Grey Frog Hawk (also called Chinese Goshawk; *A. soloensis*) are excellent species for the study the sequence of plumages on museum skins, because they have contrastingly different patterning on the underside between the juvenile and adult: boldly spotted and striped in the juvenile and finely barred (or mainly plain in the Grey Frog Hawk) in the adult. Tail feathers are boldly banded in juveniles, and particularly the inner and outer pair have reduced markings in the adult. Plumage classification is further facilitated by discrete breeding seasons, and discrete breeding and nonbreeding ranges in the Grey Frog Hawk. The migratory Grey Frog Hawk and the Asian races of the Shikra breed in spring (Ali and Ripley 1983), while in Africa the Shikra breeds late in the dry and early in the wet season, although this means in different months of the year at opposite sides of the equator (Elgood et al. 1973, Smeenk and Smeenk-Enserink 1977, Brown et al. 1982, Allan 1997). The extent of movements differs in the Shikra. The northcentral African race *A. b. sphenurus* is migratory in West Africa, where it moves north after breeding to molt (Elgood et al. 1973). It seems to be more resident in the eastern part of its range (Brown et al. 1982, del Hoyo et al. 1994). The southern African race *A. b. polyzonoides* does not undertake a regular migration, but is highly nomadic, particularly in the dry season (Allan 1997). Of the four Asian races, only the westernmost *A. b. cenchroides* is migratory (Blanford 1895, King et al. 1978, Ali and Ripley 1983, del Hoyo et al. 1994).

During work on plumages and ecology of some African Accipiters (Louette 2000, Herremans et al. 2001), we became aware of the existence in several of the smaller species of a distinct transitional plumage, kept for a short period between the typical juvenile and adult plumage. Herein, we describe this transitional post-juvenile plumage in the Shikra and Grey Frog Hawk with reference to the similar and better-documented pattern in the Levant Sparrowhawk. We report on aspects of the molt sequence relevant to the development of the transitional plumage, and on its possible function.

METHODS

We examined the plumages of the Grey Frog Hawk at the Natural History Museum (BMNH), Tring, and studied the two African and four Asian subspecies of the Shikra in the Royal Museum for Central Africa (RMCA), Tervuren, and BMNH collections: 148 *A. b. polyzonoides* (southern Africa), 119 *A. b. sphenurus* (northcentral Africa), 150 *A. b. dussumieri* (India, Bangladesh), 115 *A b. poliopsis* (northeastern India to Thailand and Vietnam), 43 *A. b. cenchroides* (Azerbaijan to northwestern India), and 32 *A. b. badius* (southwestern India, Sri Lanka) We noted the state of the plumage (juvenile/adult) separately for the contour feathers on uppersides, undersides, and rectrices and checked for active molt of primaries and tail feathers. Contour feather renewal was estimated in percent (mostly in steps of 10%) for the dorsal and ventral side separately. Sample sizes differed because some specimens were undated while, in others, the state of preparation precluded the assessment of contour molt extent, or limited extent in transitional birds precluded the comparison of ventral barring with that of adults

RESULTS

Similar to the pattern that develops in the Levant Sparrowhawk, juveniles of the migratory Grey Frog Hawk undergo a partial body molt during their first winter in southeastern Asia and Wallacea. They replace a varying amount of contour feathers and return to the breeding grounds in China in a transitional, post-juvenile plumage with a mixture of juvenile and adult-type feathers, most conspicuous on the underside because of the differences in pattern: bold barring versus almost plain rufous-buff (Fig. 2). In general, the post-juvenile contour molt appears to advance in parallel on both ventral and dorsal sides. The average individual difference between the extent of renewal of ventral and dorsal feathers was insignificant (0.25 ± 3% (±SE, range = −20%–20%; $N = 12$). We are not certain of timing of the complete molt in adults but it may terminate on the wintering grounds as evidenced by an undated adult from Jilolo Island (Moluccas) and two adults taken on Java that were growing outer primaries. However, an adult collected on 12

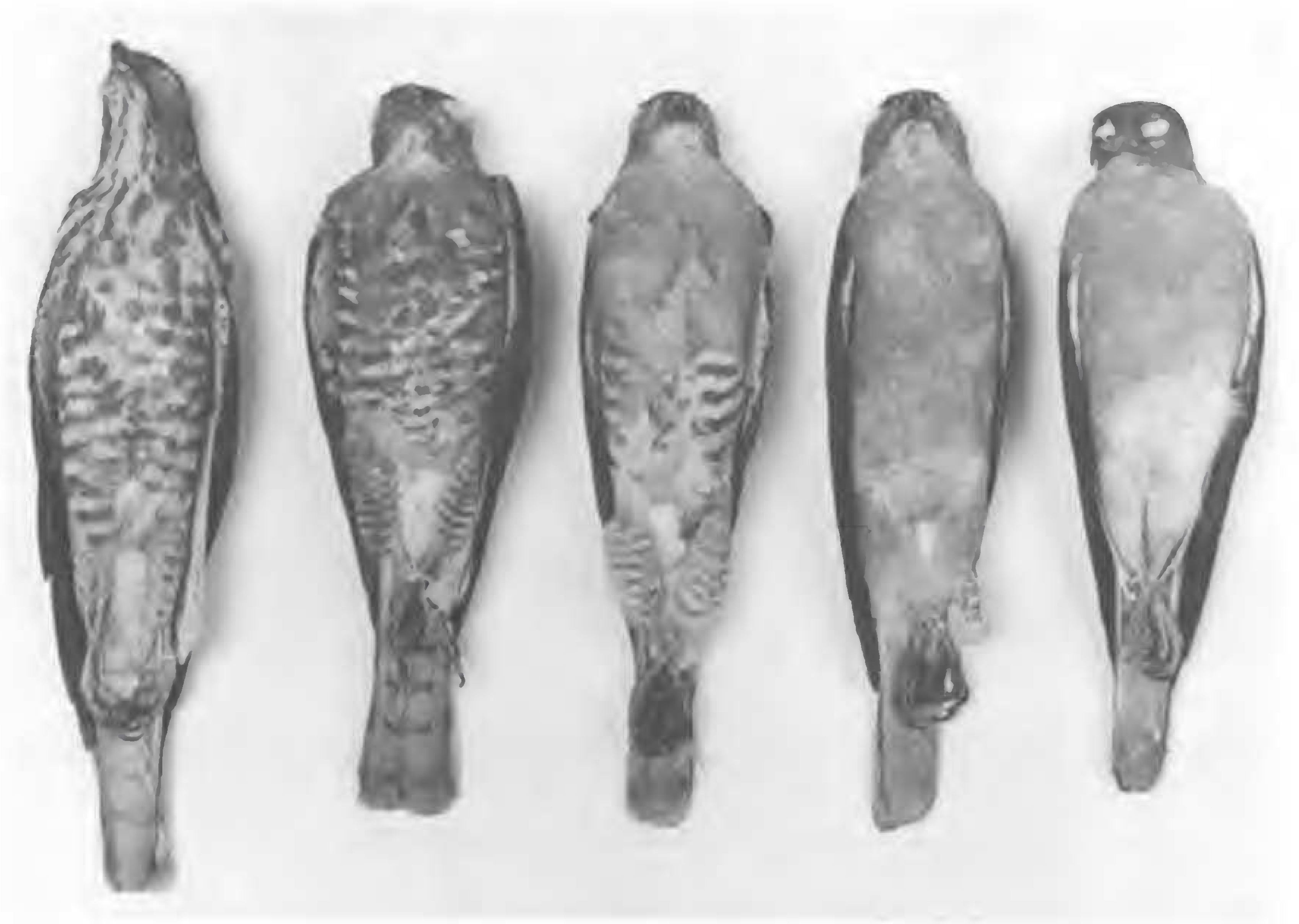

Figure 2. Ventral aspect of the plumages of the Grey Frog Hawk (*Accipiter soloensis*). From left to right, juvenile (BMNH 73.5.12.1593), no date, Batchian; transitional male (BMNH 1934.6.20.1), April, China (note underside predominantly boldly blotched and tail feathers juvenile); transitional male (BMNH 1903.7.3.94), May, China (note that fewer juvenile bars remain on lower underside and thigh feathers); adult female (BMNH 1905.12.24.955), May, China (note faintly barred on lower underside); adult male (BMNH 1914.5.1.69), March, China (plain rufous and white underside with marginal indication of barring). Photograph courtesy of the BMNH.

October in Thailand had old outer primaries but the others were newly-grown feathers, suggesting that most of the molt occurs during summer and autumn on the breeding grounds (immatures do normally return in transitional plumage to the breeding grounds, and it is unlikely that this bird had remained in its winter quarters). Adults may start molting on the breeding grounds, suspend molt during migration, and complete it in winter. The fact that some specimens showed a contrast between worn inner and new outer series of primaries seemed to confirm the existence of molt suspension.

In the southern African race of the Shikra (*A. b. polyzonoides*), the typical juvenile plumage (boldly marked below and brown with rusty edges above) was found unmolted from November–July (Table 1). Recently-fledged juveniles had been collected in November and January. From March onwards, some juveniles had molted body feathers. From May to October, body molt advancement showed great individual variation, but was never completed (Fig. 3). Because most birds examined had no growing feathers when collected, molt was apparently arrested before completion. Replacement of the juvenile plumage started on the ventral side with the upper throat. Molt on the upperside mostly started in the neck and the upper parts of the mantle, or on the head. In 44 of 47 transitional birds, replacement was more advanced on the ventral than dorsal side, while three birds had molted to a similar extent ventrally and dorsally. None of the birds that had replaced part of their juvenile plumage had already started to molt primaries or

Table 1. Monthly distribution (number of birds in collections studied) of plumage types and adult primary molt in subspecies of the Shikra (*Accipiter badius*).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	NO DATE
A. b. polyzonoides ($N = 148$)													
Juvenile	9	9	4	5	4	4	1	0	0	0	3	3	2
Transitional	0	0	2	9	11	9	5	1	7	3	0	0	6
Adult no molt	1	0	3	0	4	4	6	5	3	3	1	0	3
Adult molt	4	3	2	3	1	0	0	0	0	0	0	3	2
A. b. sphenurus ($N = 119$)													
Juvenile	0	1	1	4	1	5	6	6	2	0	3	0	0
Transitional	8	7	1	2	2	1	2	1	1	0	3	4	3
Adult no molt	6	3	5	5	5	2	0	1	1	2	3	7	1
Adult molt	0	0	0	0	2	2	2	4	1	1	1	1	0
A. b. dussumieri ($N = 150$)													
Juvenile	0	2^{a}	0	2^{a}	0	2	4	11	3	8	0	4	0
Transitional	5	3	3	2	2	0	0	2	3	5	6	3	4
Adult no molt	10	8	13	5	3	6	0	1	0	6	4	3	0
Adult molt	0	0	0	0	0	1	1	2	7	4	2	0	0
A. b. poliopsis ($N = 115$)													
Juvenile	13^{a}	5^{a}	3^{a}	3^{a} + 2	1	1^{a} + 4	5	1^{a}	3	1	4	8	0
Transitional	1	0	0	0	1	0	0	0	0	1	2	1	0
Adult no molt	11	3	3	2	3	0	0	0	0	10	3	6	0
Adult molt	0	0	0	0	0	3	1	3	6	0	0	0	0
A. b. cenchroides ($N = 43$)													
Juvenile	0	0	0	0	0	0	0	0	0	0	1	0	0
Transitional	0	1	1	0	1	0	0	0	0	0	1	1	0
Adult no molt	4	3	3	10	3	1	1	0	0	3	1	2	0
Adult molt	0	0	0	0	0	0	1	1	1	1	1	1	0
A. b. badius ($N = 32$)													
Juvenile	0	0	0	0	0	0	2	1	1	2	0	0	5
Transitional	1	0	1	0	0	0	0	0	0	0	0	0	3
Adult no molt	0	2	0	4	2	0	1	0	0	0	0	0	0
Adult molt	0	0	1	0	0	0	0	0	3	1	1	1	0

[a] Very worn plumage, indicating that no molt to transitional plumage had taken place.

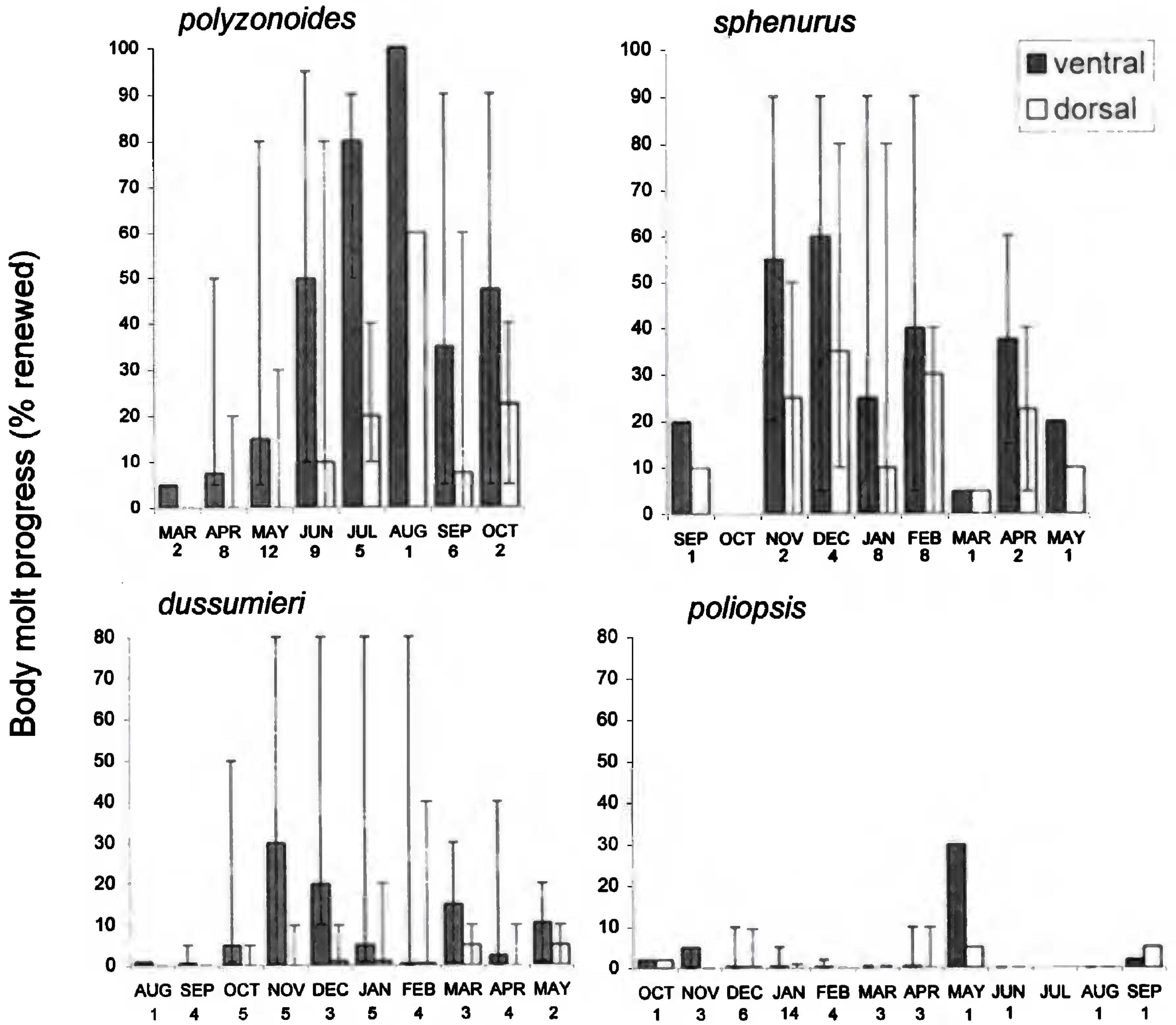

Figure 3. Progress of the post-juvenile body-molt on the dorsal and ventral side in subspecies of the Shikra (*Accipiter badius*). Monthly values for medians of ventral shown in dark bars, dorsal molt stage in white bars, and ranges in thin lines. Numbers under the figure indicate monthly sample sizes.

secondaries. One bird with well-advanced contour molt in June had new inner and outer tail feathers on both sides, but none growing. Most juveniles, therefore, acquire a transitional second plumage by a partial molt of the body feathers only, retaining most remiges and rectrices. The extent of this partial contour molt is highly variable individually (Fig. 3). A single second-year bird (BMNH 1910.7.1.108) was collected in November molting directly from a much-worn juvenile plumage to a fully adult plumage, apparently without having developed transitional plumage. Despite wide individual variation, the barring of the new feathers on the ventral side of the transitional post-juvenile plumage tended to be broader and more rusty in color than in adults (Table 2; Fig. 4). Birds changed from transitional plumage into full, adult plumage through a complete molt when about 1 year old, almost synchronous with the molt of adults. Adults undergoing a complete molt from one definitive plumage to the next were collected from December (early stages) to May (latest stages).

Recently-fledged young of *A. b. sphenurus* were dated February–September. Juveniles with transitional plumage appeared from September onwards (Table 1). The contour molt never completed, with

Table 2. Intensity of ventral barring of the transitional, post-juvenile plumage compared to adult plumage in subspecies of the Shikra (*Accipiter badius*).

	P-J > Max Ad[a]	Mean Ad <P-J < Max Ad[b]	Min Ad < P-J < Mean Ad[c]	P-J < Min Ad[d]
A. b. polyzonoides				
Males	6	5	5	0
Females	17	11	3	0
A. b. sphenurus				
Males	5	5	2	0
Females	8	4	4	0
A. b. dussumieri				
Males	7	8	2	0
Females	3	6	2	0

[a] Barring of post-juvenile plumage heavier (broader and more contrasting) than the maximum barring in adults.

[b] Barring of post-juvenile plumage in between the heaviest and average barring of adults.

[c] Barring of post-juvenile plumage in between the average and weakest barring of adults.

[d] Barring of post-juvenile plumage poorer developed than weakest barring of adults.

great variation in the extent of renewal among individuals (Fig. 3). In general, we suspect a tendency for a less extensive transitional plumage than in *A. b. polyzonoides* (Fig. 3). Of 30 transitional birds, 26 had molted more extensively ventrally than dorsally; three had progressed equally and one had the upperside more extensively molted. One second-year bird (RMCA 102759) was molting directly from a much-worn juvenile plumage to the adult plumage with a complete molt, apparently without having developed a transitional post-juvenile plumage. In it, the bars on the underside of the transitional plumage tended to be more strongly marked than those of adults (Table 2; Fig. 5). One bird collected in February and several more collected between May and September were undergoing a complete molt from transitional post-juvenile plumage to full adult plumage and, therefore, when about one year old. Adults undergoing complete molts from one adult plumage to another were collected from May (early stages) to December (latest stages).

In *A. b. dussumieri*, recently-fledged juveniles were dated June–July and juveniles in fresh plumage were found until October. From August onwards, birds started to develop transitional plumage (Table 1; Fig. 3). Despite the great individual variation in extent of the contour molt, replacement was less extensive than in the African races (Fig. 3). Four birds had very worn juvenile plumages in February and April, indicating that they would most likely not have developed transitional plumage, but would have molted directly from worn, juvenile plumage to adult plumage with a complete molt (Table 1), similar to the few examples in the other races mentioned above. All of 37 transitional birds had molted more extensively ventrally than dorsally. Again, new feathers of the transitional plumage tended to be more prominently barred than in the adult plumage (Table 2; Fig. 6). No transitional birds were found during the complete molt into adult plumage, but this molt is likely to be synchronous with that of adults, which occurs shortly after breeding, from June–November (Table 2).

In *A. b. poliopsis*, recently-fledged juveniles were dated April–September. Few juveniles developed transitional plumage, and if so, mostly did so to a small extent, making it sometimes difficult to distinguish between transitional molt and accidental feather replacement (Table 1; Fig. 3). When 6–12-mo old, most juveniles had heavily-worn, juvenile plumage, without any sign of transitional post-juvenile plumage (Table 1). Consequently, the barring of the transitional plumage could not be compared to that in the adult plumage. One juvenile (BMNH 87.11.1.165) was in complete molt in June, changing feathers directly from a very worn juvenile plumage to the adult plumage. All of the individuals with worn plumage that were collected from January–June (Table 1) were expected to follow the same pattern. Birds in transitional plumage underwent a complete molt to adult plumage in April, May, and August, possibly slightly earlier than the molt in adults, which occurred June–September, after breeding (Table 1).

Specimens of *A. b. cenchroides* and nominate *A. b. badius* were limited. Several specimens of both races were in transitional plumage (Table 1). Of five transitional *A. b. cenchroides*, one had 80% of the ventral plumage renewed by December, another 60% by February, and the remainder had <15% new feathers. All five transitional *A. b. badius* had >20% renewed feathers ventrally, and three had 70–90% renewed. The limited data suggested that, among the Asian races, *A. b. badius* may develop the most extensive transitional plumage, while molt extent in the migratory *A. b. cenchroides* ap-

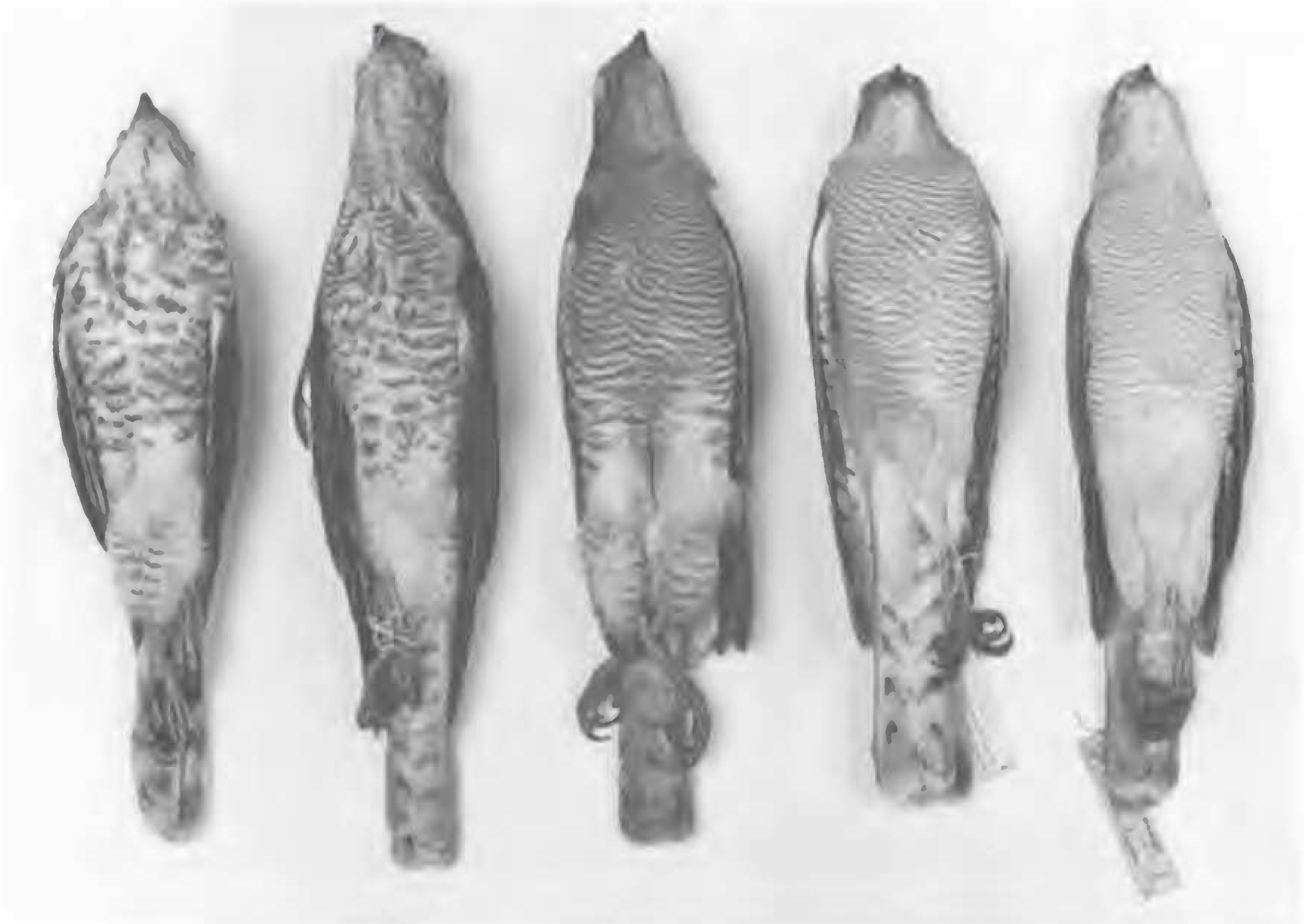

Figure 4. Ventral aspect of the plumages of the Shikra (*Accipiter badius polyzonoides*). From left to right, juvenile male (BMNH 1911.12.23.430), January, Zambia; transitional female (BMNH 1950.50.125), April, Namibia (note limited replacement and new feathers more prominently barred than in adult); transitional female (BMNH 80.1.30.3), no date, Zambia (note only some barring from juvenile plumage remaining on flanks and thighs, juvenile tail, and replaced feathers on underside more prominently barred than in adult); adult female (BMNH 1932.5.10.598), March, Tanzania; adult male (BMNH 94.6.16.170), no date, Zambia. Photograph courtesy of the BMNH.

pears more similar to *A. b. dussumieri.* There were too few specimens to compare the post-juvenile barring with that of adults. Adults had been collected from nests with eggs in April for *A. b. cenchroides,* and molt in adults also followed breeding in this race (Table 1). From the timing of appearance of juveniles in the population and molt in adults (Table 1), it appeared that the same molt pattern also applied to the nominate race *A. b. badius.*

DISCUSSION

In *A. brevipes, A. soloensis,* and *A. badius,* juvenile birds in nestling plumage have undersides with large rufous-brown spots and stripes, and broad barring on the flanks; the upperside has rusty brown edges to a generally dark brown plumage and all tail feathers are heavily banded. A transitional plumage occurs in the second half of the first year of life during which time remiges, most of the rectrices, and most of the larger upper wing coverts are retained from the juvenile plumage, but between 4–10 mo of age some of the body feathers are replaced. New feathers on the upperside resemble the adult type, while those on the underside become barred with a tendency for wider, bolder barring than in adults. The extent of the partial contour molt is highly variable between individuals and taxa, and some juveniles do not develop transitional plumage at all, particularly those of the race *A. b. poliopsis* of the Shikra. In it, the transitional plumage is replaced by adult plumage during a complete molt when one year old, more or less synchronous with the complete molt of

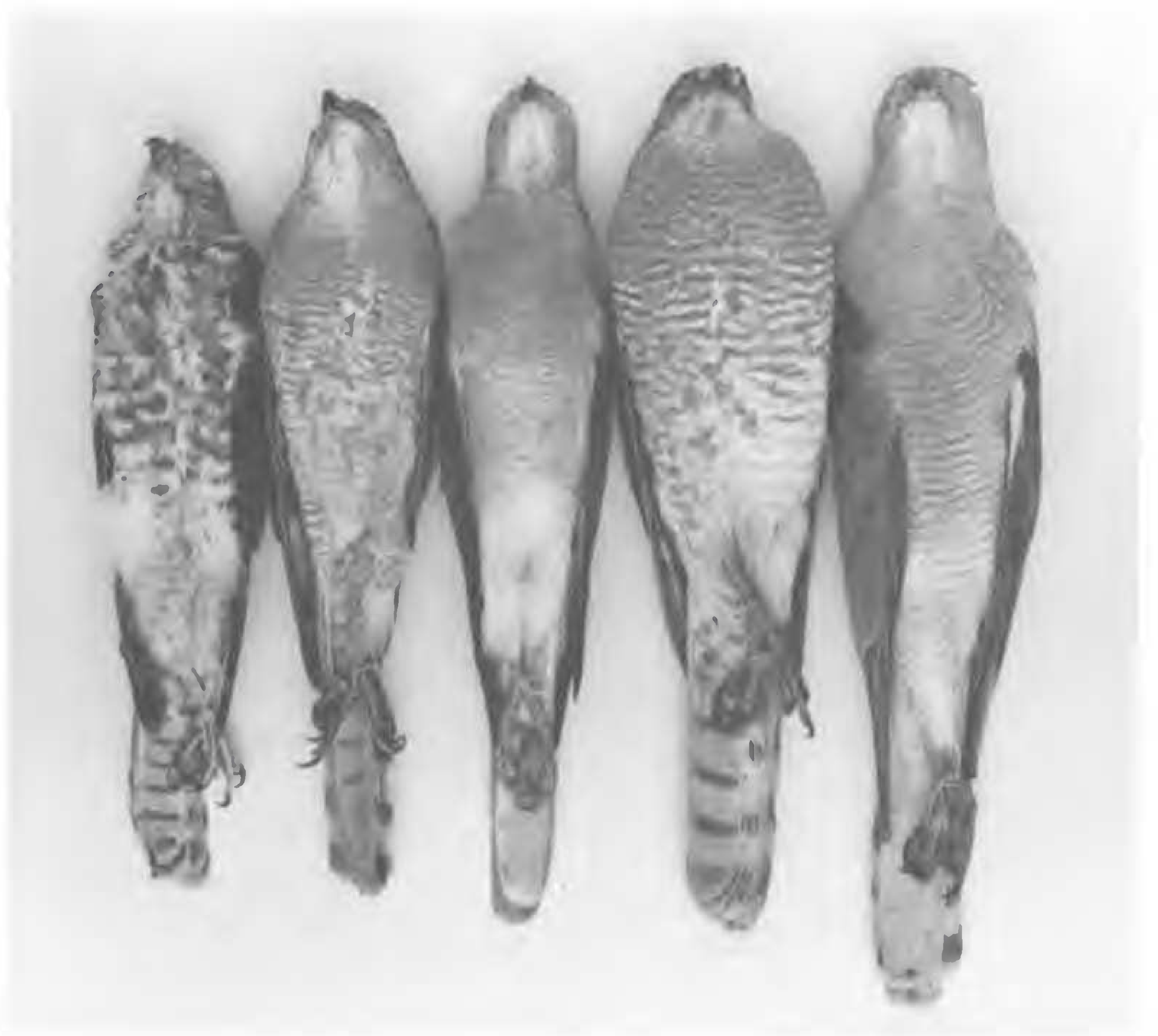

Figure 5. Ventral aspect of the plumages of the Shikra (*Accipiter badius sphenurus*). From left to right, juvenile male (RMCA 109477), July, Ethiopia; transitional male (RMCA 102.759), May, Uganda (note some spots from juvenile plumage left, tail juvenile and heavily banded, and more distinctly barred underside than adult); adult male (RMCA 95921), August, D.R. Congo (note less distinctly barred than female and unmarked outer tail feathers); transitional female (RMCA 102.736), June, Kenya (note some spots left from juvenile plumage, tail juvenile and heavily banded, and more prominently barred than adult); adult female (RMCA 103.515), November, D.R. Congo (note more distinctly barred than adult male, but less than post-juvenile female, unmarked outer tail feathers).

adults. Adults are uniformly bluish-grey dorsally (dark slate in *A. b. soloensis*) and have barring on the underside (almost plain in *soloensis*); females are generally more prominently barred than males. At least some tail feathers of adults have reduced banding. Adult plumage is replaced by a complete molt following breeding.

We lack information on whether birds may or may not breed when 1 year old and in transitional plumage. In migratory species such as the Levant Sparrowhawk and Grey Frog Hawk, transitional birds migrate to the breeding grounds. Brown et al. (1982) indicated that the Shikra might breed at one year of age, while Thiollay (1975) suggested that some birds do not breed at age one. Zimmerman et al. (1996) felt that the race *A. b. sphenurus* might breed in transitional plumage but no cases of it were observed in *A. b. polyzonoides* by Tarboton (2000).

Schmitt et al. (1982) found that half of the 20 juveniles caught in South Africa were undergoing solely a contour molt in April and May, most likely the partial contour molt of the post-juvenile plumage we report here. The fact that a bird they clas-

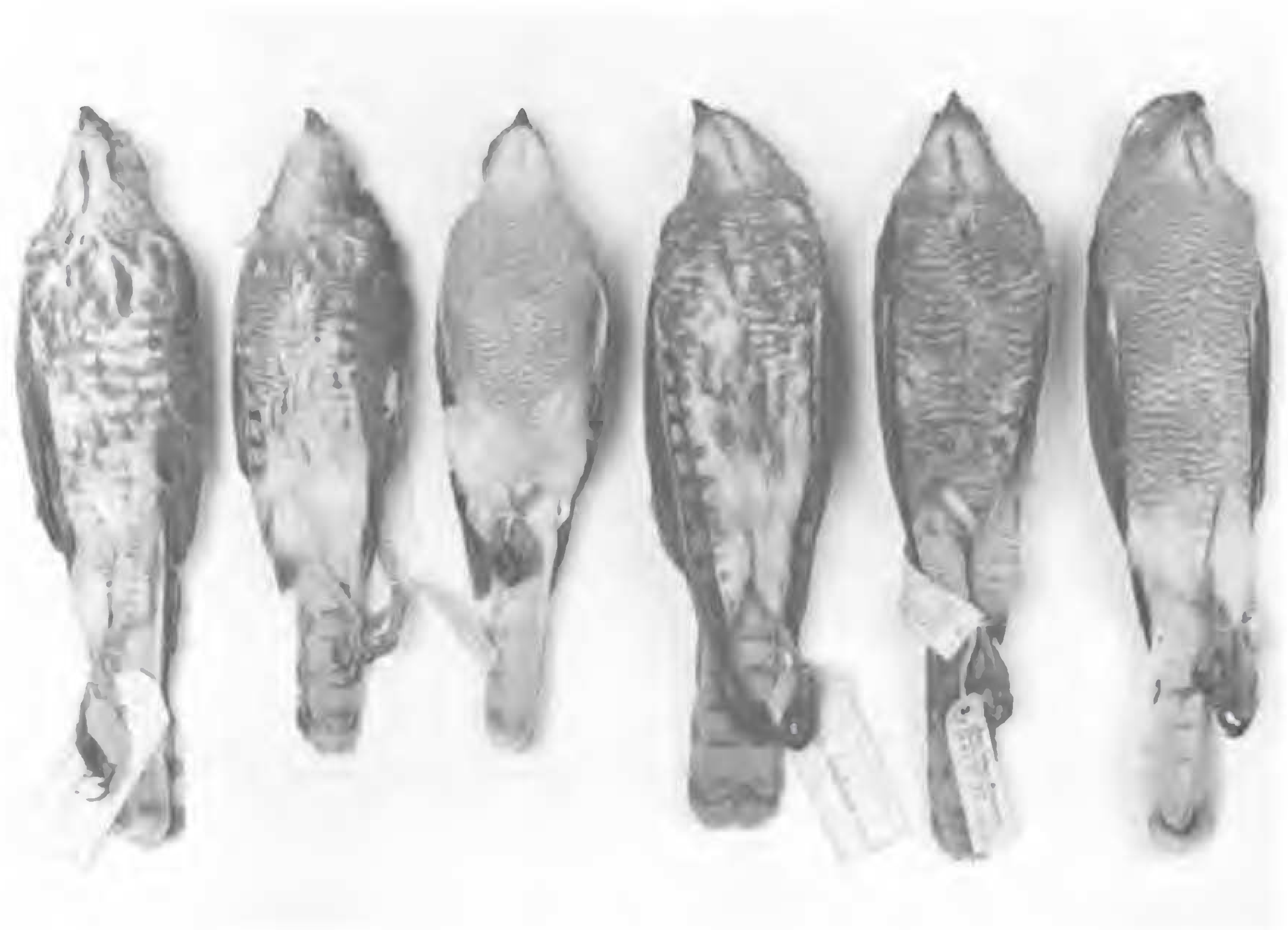

Figure 6. Ventral aspect of the plumages of the Shikra (*Accipiter badius dussumieri*). From left to right, juvenile female (BMNH 85.8.19.487), no date, India; transitional male (BMNH 85.8.19.481), October, India (note some spots from juvenile plumage left, tail juvenile and heavily banded, and more distinctly barred underside than adult); adult male (BMNH 1949.WHI.1.223), March, India (note underside less distinctly barred than female and unmarked outer tail feathers); transitional female (BMNH 85.8.19.508), March, Nepal (note many blotches left from the juvenile plumage, tail juvenile and heavily banded, and ventrally more prominently barred than adult); transitional female (BMNH 1949.25.87), November, Rawalpindi, Pakistan (note a few blotches left from the juvenile plumage and more prominently barred than adult); adult female (BMNH 86.3.25.79), December, India (note more distinctly barred than adult male but less than transitional female, and reduced markings on outer tail feathers). Photograph courtesy of the BMNH.

sified as a juvenile in May was recaptured a year later in adult plumage should not be seen as proof for the absence of an intermediate plumage. In fact, their observations fit exactly the plumage sequence we present here. A bird in recognizable juvenile plumage in May, whether or not the replacement of body feathers has started, is expected either to be in the transitional plumage or to have molted recently from the transitional to the adult plumage by next May. Schmitt et al. (1982) did not recognize the barred transitional plumage as different from the adult and, therefore, identified the bird as an adult when recapturing it a year later. The individual they caught may have showed complete, adult plumage adding further evidence that the transitional plumage is retained for only about half a year and is replaced by the adult plumage in synchrony with the molt of breeding adults. We found several specimens for the different taxa molting from transitional plumage to adult plumage with a complete molt at about the same time as adults undergo the complete post-breeding molt. This meant that the transitional plumage is only worn for about half a year. Some transitional birds may molt slightly ahead of adults with nonbreeding birds molting earlier.

If the transitional plumage is only retained for about half a year, are the feathers molted during the first year replaced again in the subsequent molt to adult plumage, or is all replacement part of the same molt cycle, with part of the contour molt shifted half a year forwards? Is the transitional plumage, therefore, a distinct plumage, or is it merely part of a protracted molt process? A pattern of a protracted molt with advanced contour molt would be similar to that found in several long-distance migrants (e.g., waders in the genus *Calidris*, Cramp and Simmons 1983) and in some swallows (*Hirundo* spp., *Delichon* spp., *Riparia* spp.) and warblers (*Acrocephalus* spp., *Locustella* spp., *Hippolais* spp., *Sylvia* spp., Jenni and Winkler 1994), which start a contour molt when still on the breeding grounds during the northern summer, but postpone the replacement of most remiges and rectrices of the same molt cycle until arrival on the wintering grounds some months later. In accipiters, if feathers of the transitional plumage are not replaced after half a year, there should be birds in the population with new, adult-type rectrices and two generations of contour feathers with undersides showing a mixture of worn, prominently barred feathers from the transitional plumage, and fresh, less barred, adult feathers. We have not found such birds in collections. Furthermore, because markings on the undersides of transitional birds were on average more prominent, we concluded that the molt at age one included all feathers. We found no evidence in the *Accipiter* literature of a possible split molt, whereby replacement of body feathers significantly precedes that of flight feathers during the same molt cycle. In the Eurasian Sparrowhawk, replacement of the primaries spans the entire molt period and no significant body molt occurs outside the period of primary replacement (Newton and Marquiss 1982). However, it has a rather variable plumage with poorly-differentiated adult and juvenile patterns (Nilsson 1992, Engström and Edelstam 1995). Although it is the best studied *Accipiter* species, it may thus be an unfortunate choice as the standard for the genus illustrating plumage sequences.

The transitional plumage in the three accipiters we studied clearly showed a separate, intermediate feather generation between juvenile and adult plumages (Humphrey and Parkes 1959). It results from its own, albeit partial and individually-variable contour molt, giving a plumage type which is different from that of adults.

Recently, a second-year plumage was described from the South American Gray-bellied Hawk (*A. poliogaster*), a species with a unique juvenile plumage (Whittaker and Oren 1999). We found a second-year plumage with broader ventral barring than in adults in the Mayotte subspecies of the Frances' Sparrowhawk (*Accipiter francesiae brutus*, Herremans et al. 2001). A transitional plumage, after a partial contour molt, is also more frequent in the Black-shouldered Kite (*Elanus caeruleus*) than previously known (Herremans 2000). The occurrence of early, partial post-juvenile molts in small raptors seems to be associated with a distinctive juvenile plumage with the underside pattern differing from that of adults. There are regions in the world where several accipiters, with essentially the same juvenile plumage co-occur (e.g., King et al. 1978, Zimmerman et al. 1996), and molt into a more adult-like plumage may be essential for proper species recognition before they can enter the breeding population. However, interspecific pressures may not be the main force behind the early molt, because the phenomenon also exists where no confusing juveniles of other species co-occur (e.g., on Mayotte Island: Herremans et al. 2001). At this point we are uncertain how it functions but the underside plumage is probably important in social communication in accipiters. Under this functional hypothesis, it is important that the adult-like ventral plumage be acquired before the start of the next breeding season. In the well-marked race of the Shikra (*A. b. poliopsis*), the sexual differentiation in ventral colors and patterning of adults is minimal and less than in the other races and the transitional, post-juvenile plumage is poorly developed. Possibly, the development of the transitional plumage functions as an early indication of the individual's sex and, because of the poor sexual plumage dimorphism of adults, there is no functional need for young *A. b. poliopsis* to change plumage at an early stage. Individual variation in the development of the post-juvenile molt might be dependent on condition and age, and the extent could also vary between years. Molt variation could, therefore, offer juveniles opportunities to advertise their sex, age, and individual quality. Age and quality have been demonstrated to have important impact on breeding performance in the Eurasian Sparrowhawk (Risch 1998), and it is likely that early advertisement of sex and quality for young birds entering their first breeding season is ultimately beneficial for their reproductive performance. Under this hypothesis, aspects such as differences in territorial establishment, mating success, or recruitment into the breeding population at age one, may prove to be related to the extent of the post-juvenile molt.

Kemp (1999) demonstrated an early partial contour molt in the Greater Kestrel (*Falco rupicoloides*) which coincided with changes in territorial behaviors of adults. Small investments in a partial, post-juvenile molt, paralleled by changes in soft parts (e.g., eye color) resulted in important effects on communication and signaling. As in most accipiters, eye color changes with age in the Shikra from pale bluish-yellow in the fresh juvenile to yellow or orange in the transitional plumage and bright red in adults, with some variation according to sex and race. As in the Greater Kestrel, such changes in eye color could contribute to age and sexual communication in the Shikra.

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